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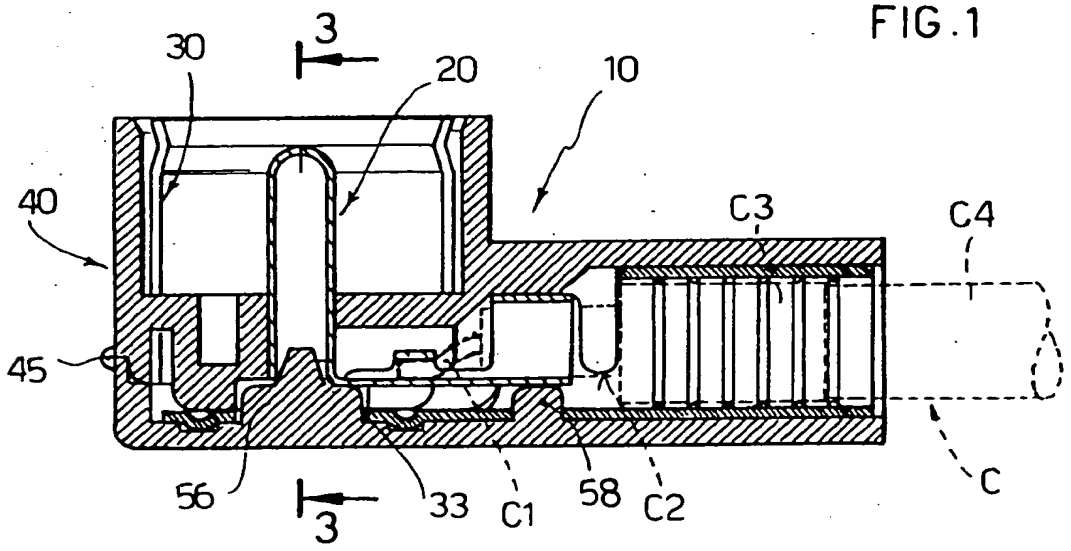
(54) Multi-component electrical connector and manufacturing process

(57) A connector, particularly for car radios, comprising a first component (20), or inner contact, made of sheared and curved foil, a second component (30), or outer contact, made of sheared, curved foil; and a insulating plastic body component (40) premolded in two parts (42, 44), either pivoted together or in any case provided with means for joining one to the other. The connector is assembled first by clinching the first component or inner contact onto the central axial conducting wire (C_1) of a coaxial cable (C) suitably cut and stripped, then clinching the second component or outer contact onto the braided wire (C_3) of the suitably stripped cable and then applying the body (40) on said components so as to insulate them from one another and enclose them.

FIG.1



Description

[0001] The invention refers to electrical connectors for coaxial cables, that is, cables comprising a central conducting wire and a conducting braiding coaxial to the wire and insulated therefrom. Said connectors have a central pin-shaped contact and an outer peripheral cup-shaped contact, both enclosed within a insulating body and provided with connection means for electrical connection to said cable.

[0002] Said components are used particularly in the car radio field and in the television field. There is a constant search to reduce and automate connector assembling operations. On the other hand, the connector characteristics are set in very precise specifications from which it is not possible to depart.

[0003] The most recent state of the art is an angular connector comprising: a inner contact element made of pressed bent sheet metal forming a central pin-shaped part and a clinching or seaming part for clinching to a central conductor wire of a coaxial cable; an outer contact element made of punched and bent sheet metal forming an annular part and, connected thereto, a part having arms for fixing to a braiding of a coaxial cable; an inner insulating element disposed between said first and second contact elements, and an outer plastic insulating body which is injection molded on an assembly made of the first and second contacts preassembled on the cable.

[0004] Although said connector has been an advance in the art, the assembly operations nevertheless require precise positioning of the parts one with respect to the other and furthermore positioning of the parts, preassembled on the cable, inside the plastic injection mold requires time and skill.

[0005] The problem of optimizing production of angular connectors for coaxial cables therefore remains open.

[0006] With this objective in view, a connector according to the present invention has been devised as defined in claim 1 and a manufacturing process thereof as defined in claim 10.

[0007] Individual components of the connector and a clinching process also are subject matter of the invention.

[0008] The new connector comprises: a first "inner contact" component; a second "outer contact" or "peripheral contact" component; a third "body" or "housing" component that provides insulation between the contacts and around the outer contact.

[0009] The inner contact component is made of punched and bent conductor sheet metal or foil and comprises a contact plug or pin and a connecting part, in electrical continuity with each other, the connecting part comprising a first pair of connecting tongues for connecting to a central wire of a coaxial cable and a second pair of connecting tongues for connecting to an insulating sheath of the coaxial cable.

[0010] The second component is made of punched and bent conducting sheet metal or foil and comprises a first annular contact part generally in the form of two half-rings or half-cups and a second connecting part in electrical continuity with the first part. If the connector is angular, the first part and the second part are arranged along axes at right angle to each other. The connecting part comprises a first pair of shielding tongues and a second pair of clinching tongues, the latter to clinch the coaxial cable partly on an exposed braiding of the cable and partly on an outer insulation thereof.

[0011] The third, insulating component is made of premolded plastic and is comprised of two half-shells with engaging means for engagement with each other to form a shell. In one embodiment the two half-shells comprise a half-shell extending on the same side as the contact pin and the contact cup, which forms an insulation between the contact pin and the contact cup, and an opposite back or covering half-shell, the half-shells being pivotally joined together. In an alternative embodiment the plastic shell is shaped with a back part having a connected half-cup, and a second part forming an other half-cup and an insulating portion between the contacts, and the two parts are locked together.

[0012] Subject matter of the invention is also a manufacturing/assembling process for a connector as defined above, which comprises the steps of providing a first or "inner contact" component made of cut and bent conducting sheet metal or foil; providing a second or "outer contact" component made of cut and bent sheet metal or foil; providing a third or molded plastic insulating shell component; providing one end of a coaxial cable cut and stripped so as to expose a part of a central wire and a part of a braiding thereof; assembling said first component on said cable by clinching first tongues of the first component on the central wire of the cable and second tongues of the first component on an insulating sheath of the cable, situated between the central wire and the braiding; assembling said second component on the cable by clinching second tongues of the second component on the braiding of the cable and on part of the outer sheath of the cable; assembling the third component on the first two components thus assembled and fixing together two parts thereof.

[0013] The new connector and manufacturing/assembly process enable assembling times and the relative costs to be reduced. The new connector is suitable to be assembled completely automatically on usual so-called "cut-strip-clinch" machines.

[0014] The connector is particularly useful in the field of radio - TV aerials and signal transmission between hi-fi systems.

[0015] Unrestrictive exemplary embodiments of the invention will be described below with reference to th attached drawings in which:

Figure 1 is an enlarged axial longitudinal sectional view of a first embodiment of a connector; an end of

a coaxial cable to which it is applied is drawn in dash lines;

Figure 2 is a plan view of the connector in Figure 1; a wall part of the third shell component has been removed to show the parts beneath.

Figure 3 is a sectional view taken along a plane referenced 3-3 in Figure 1;

Figure 4 is an enlarged plan view of a first or central contact component, during shaping of a punched sheet;

Figure 5 is a bottom view with respect to Figure 4;

Figure 6 is a side elevational view similar to Figure 5 of the first contact component complete and ready for assembly;

Figure 7 is an elevational view from the right with respect to Figure 6;

Figure 8 shows a chain of second components in a broken-off plan view, on an enlarged scale;

Figure 9 shows a second component separated from the chain, seen from below with respect to Figure 8;

Figure 10 is a view from the left with respect to Figure 9;

Figure 11 is a view from the right with respect to Figure 9;

Figure 12 is an enlarged plan view of an insulating shell component, in an opened condition;

Figure 13 is a view from the right with respect to Figure 12;

Figure 14 shows four successive steps in assembling the connector of the invention on an end of a coaxial cable, namely: Figure 14a shows a previously cut and stripped coaxial cable end; Figure 14b shows the end of the cable with the first component assembled; Figure 14c shows the end of the cable with the first and second components assembled; Figure 14d shows the end of the cable with the third component assembled;

Figure 15 shows the clinching steps of the process of the present invention, that is, Figure 15a shows a first step; Figure 15b shows an intermediate step; figure 15c shows a further intermediate step and Figure 15d shows a final step, with clinching completed;

Figure 16 is a median, exploded, enlarged, longitudinal sectional view of a variant of the third component;

Figure 17 is an axial, longitudinal sectional view of an assembled connector comprising the component in Figure 16;

Figure 18 is an exploded, enlarged, longitudinal sectional view of a further variant of the third component;

Figure 19 is an enlarged, axial, longitudinal sectional view of an assembled connector comprising a component as shown in Figure 18;

Figure 20 is an axial section through a coaxial type connector;

Figure 21 is a side view of a "peripheral contact" component of the connector in Figure 20;

Figure 22 is a view from the right with respect to Figure 21;

Figure 23 is an axial, longitudinal section through the insulating shell component of the connector in Figure 20.

[0016] With reference first to Figure 1; a pin connector having two contacts, a central contact and a peripheral contact, is referenced 10 as a whole and is shown assembled on a coaxial cable referenced C. In this example, the connector is angular, is referenced 10 and comprises a first central contact component referenced 20, a second peripheral contact component referenced 30, and a third insulating shell component referenced 40.

[0017] The first component will now be described in greater detail with reference to Figures 4 to 7. As can be seen in Figure 6, therefore, the component 20 comprises a pin-shaped part 22 and a connecting part 23 connected thereto and at right angles thereto. The connecting part 23 comprises first tongues 24-24 and second tongues 25-25. The first tongues 24 have a limited lateral extension and are in an intermediate position with respect to the pin part 22 and the second tongues 25. The second tongues 25 have a greater extension than the first. Both the first tongues and the second tongues, as can be better seen in Figure 7, are preferably preformed with a shape extending on the same side and the tongues 25 have a slightly curved shape. The curve of one tongue 25 and the other is not specular but one tongue has its end further from the base than the other, to facilitate clinching to cables with different diameters.

[0018] The element 20 is obtained from flat, cut and bent conducting sheet metal or foil. In particular, the

cylindrical pin part is bent so as to close along a generating line. A plurality of components 20 are preferably provided as a continuous band and, as illustrated in Figure 4, joined to a sheet metal ribbon F, which can be seen in said figure, through a narrow neck F'. Once the neck F' has been broken, each component 20 can easily be bent into the position in Figure 6. The fact of providing the component as a continuous ribbon is particularly useful for automatic assembling.

[0019] The second component 30 can be seen clearly in Figures 8 to 11. Figure 8 shows a plan view thereof in cut and bent form, but as a continuous band, in which a plurality of components 30 are connected to each other by means of narrow necks. Each component 30 comprises a base part 31 from which two tabs 32 and 32 extend from diametrically opposite sides, said tabs being folded upwards, in Figure 9, and bent in an arc of a circle, so as to define a cup part with diametrically opposite openings. The base part has a circular opening at the bottom defined by an edge 33. The base part extends axially on one side and forms a first pair of tongues 34-34 and a second pair of tongues 36-36. The tongues 34-34 extend upwards substantially parallel to each other and an opening 35 is provided in the base portion therebetween. The tongues 34, 34 have a shielding function in the assembled connector. The tongues 36-36 are bent one toward the other with a non-symmetrical curvature, as previously explained with respect to the tongues 25 of the first component, to facilitate clamping to cables of different diameters. The tabs 32, bent into a cup in the usual manner, have a narrowing 32' near the edge.

[0020] The shell component 40 will now be described with reference to Figures 12 and 13. The component 40 comprises two half-shells 42, 44 pivotally integral to each other along line 45. The half-shell 42 comprises a cup-shaped part 46 able to be disposed around the cup part of the second contact component and a body part 48 integral therewith. The bottom part 47 of the cup part has a through opening 51. The bottom 47 comprises an annular part provided to insulate the first contact from the second contact. The half-shell 42 comprises a plurality of peripheral teeth referenced 52, having an arrow-like shape in sectional view or a per se known shape suitable for coupling. The half-shell 44 comprises a base 54 from which insulating support portions extend, i.e. a first central support portion 56 and a second support portion 58. The half-shell 44 has teeth engagement openings referenced 62.

[0021] Assembling of the connector on the end of a coaxial cable will now be described with reference to Figure 14. An end of the coaxial cable C is cut and stripped with conventional means in order to present an end C_1 of the central conductor exposed for a length. Around it an end of an inner insulating sheath C_2 between the central conductor and the braiding wire C_3 surrounding it is exposed for an adjacent length. The sheath C_3 is exposed for an adjacent length and is covered by the outer sheath C_4. In a first step, the first component is clinched with its tongues 24 around the central conductor C_2 and with its tongues 25 around the inner insulating sheath C_2.

[0022] If required, to improve the connection, C_1 can also be soldered or electrically spot welded to the tongues 24.

[0023] In a subsequent step, the second component 30 is positioned around an intermediate product consisting of the cable plus the first component, and fixed thereto disposing the cup part or tabs 32 around the pin part 22 and spaced therefrom, the tongues 34 at the sides of the tongues 25 and the tongues 36 wrapped and closed (clinched) so as to grip the braiding C_3 and the sheath C_4.

[0024] Then, as illustrated in Figure 14d, the shell component 40 is applied to the semifinished product in Figure 14c, disposing the cup part 46 around the cup part 32 and the body part 48 to cover the parts 34 and 36. The base 44 is then folded around the pivot line until the teeth 52 and the opening 62 are engaged with each other. In this manner the insulating spacing part 56 is disposed through the hole 33 of the component 30 and the insulating spacing part 58 is disposed through the hole 35 of the component 30, and both cooperate to support the first component 20 in the correct position with respect to the second component and insulated therefrom.

[0025] In Figures 15a and 15d a clinching (also said clamping or crimping) process particularly useful for clinching the tongues 25-25 or 36-36, but not limited to use therewith, is described. Said process will now be explained for clinching tongues 25-25 which solely for said figure are called 25f, the one situated on the left, and 25d, the one situated on the right. Clinching dies are referenced 70 for the bottom die and 72 for the top die. Reference C denotes a cable on which the tongues 25, 25 must be clinched.

[0026] As can be seen, the bottom die is of a traditional type with a cavity 70' of a shape corresponding to the joining part of the tongues that must be clinched. The tongue 25s has a curved end 25's at a slightly lower level than a curved end 25'd of the right-hand tongue; obviously a specular arrangement can also be provided. The upper fixture 72 has a particular cavity 73 with an asymmetrical configuration with respect to a axis a shown vertical through the center of the cable C (dotted and dashed line in the figures), and to be precise the shape comprises a sloping portion 73s on the left and a sloping portion 73d on the right in the figure, forming roughly equal angles with respect to the axis a, but whereof the portion 73s is nearer to the axis a than is the corresponding portion 73d on the right in the figure. In this manner the branch or tongue 25s is forced to bend around the cable c and come close thereto before the corresponding tongue 25d, as can be seen in Figure 15b and in the next Figure 15c. The cavity 73 ends in a part shaped like an arc of a circle 73c which comes into

operation in the step corresponding to Figure 15d, to press down the tongues one on top of the other around the cable C.

[0027] It should be noted that this clinching method and apparatus that allows automatic adaptation to cables with different diameters and sections, though particularly useful in relation to the connector of the invention, could also be used in other fields.

[0028] In figure 16 a third shell component according to a variant of the invention is illustrated. In this case the shell component is denoted as a whole with reference numeral 140 and is comprised of a half-shell 142 and a half-shell 144. The half-shell 144 comprises a first wall portion 146' of a cup part and a base part 154 with spacing protrusions 156 and 158. The half-shell 142 comprises a bottom portion 147 of the cup part, a second wall portion 146" of the cup part and a covering part 148. The half-shell 142 and the half-shell 144 are assembled together by locking means not illustrated, which comprise, for example, an opening 162 in the half-shell 144 and a tooth 152 in the half-shell 142.

[0029] Figures 18 and 19 illustrate a further variant 240 for the shell component. The component 240 comprises a half-shell 244 shaped with a first portion 246' of a cup part, an opening 262, and insulating and spacing protrusions 256, 258 similar to the protrusions 56, 58 described previously. It further comprises a second half-shell 242 with an engaging tooth 252, an insulating part between the contacts 247 and a second portion 246" of the cup part.

[0030] Figure 20 illustrates a connector 300 of a coaxial in-line type. It is assembled from: an inner component 20, substantially identical to what is shown in Figure 5; a peripheral connector 330 comprising an in-line cup part 332, shielding tongues 334 and clinching and connecting tongues 336, and a shell component 340. A part thereof, 344, incorporates a cup portion 346 and an inner insulating part 347. A part 342 is pivoted at 345 to the part 344. References 352 and 362 denote retaining means.

[0031] Other component shapes can be thought of within the scope of the invention.

Claims

1. An electrical connector for coaxial cables comprising an insulating body or shell, a first inner contact component comprising a pin part and connecting parts for connection to a cable, a second peripheral contact component comprising a cup part and connecting parts for connection to the cable, characterized in that said insulating shell is a premolded plastic component (40; 140; 240; 340) and incorporates insulation parts between said first (20) and second (30; 330) component.

2. An electrical connector according to claim 1, characterized in that said shell (40; 340) comprises two half-shells (42, 44; 342, 344) pivotally connected to each other (45, 345).

3. An electrical connector according to claim 1, characterized in that said shell comprises two half-shells (42, 44; 142, 144; 242, 244; 342, 344) with engagement means (52, 62; 152, 162; 252, 262; 352, 362) for engagement of said two half-shells.

4. An electrical connector according to claim 2, characterized in that a first half-shell (42) comprises a cup part (46) and an insulating part (47) between the first and second component and the second half-shell (44) comprises a base part and spacer parts (56, 58) to space the first and second component from each other.

5. An electrical connector according to claim 3 characterized in that a half-shell (144; 244) comprises a portion of the cup part (146'; 246') and the base part (154, 254) and the other half-shell (142; 242) comprises another portion of the cup part (146"; 246") and an insulating part (147; 247).

6. An electrical connector according to claim 1, characterized in that the first contact component (20) is made of cut and bent conducting sheet or foil and comprises a pin-shaped part (22) and a connecting part substantially at right angle to each other, the connecting part comprising first tongues (24) for clinching to a central conductor of a coaxial cable and second tongues (25) for clinching to an inner insulating sheath of said cable.

7. An electrical connector according to claim 1, characterized in that said second component (30) is made of cut, bent sheet or foil and comprises: a cup part formed by two tabs (32) bent and curved into an arc of a circle so as to present two openings along diametrically opposite sides, and a connecting part with its axis at right angle to the axis of the cup part and having shielding tongues (34) and connecting tongues (36) for clinching.

8. An electrical connector according to claim 1, characterized in that said second component (330) is made of cut and bent conducting sheet or foil and comprises: a cup part formed by a tab/tabs (332) bent and curved into an arc so as to have a longitudinal opening; a connecting part aligned with the axis of the cup part and having shielding tongues (334) and connecting tongues (336) for clinching.

9. An electronical connector according to any one of the preceding claims characterized in that the clinching tongues have an asymmetrical shape one with respect to the other, the distal edge of one tongue being further away with respect to the distal

edge of the other tongue to be clinched therewith.

10. A manufacturing process for manufacturing an electrical connector assembled on the end of a coaxial cable characterized in that it comprises the following stages:

a) providing a first component of an inner pin contact type, made of cut and bent sheet or foil;
b) providing a second component, of the outer contact type, made of cut and bent conducting sheet or foil;
c) providing a third component in the form of a premolded plastic insulating shell comprising insulating parts between the first and second component and outer body parts to enclose and insulate said first and second component;
d) providing an end of a coaxial cable stripped so as to have exposed a portion of an inner or central conductor thereof, an adjacent portion of an internal insulation and an adjacent portion of a braiding;
e) assembling said first component by clinching tongues thereof on said inner conductor;
f) assembling said second component disposed around said first component, by clinching tongues thereof on said braiding;
g) assembling said third component around and inside said first and second component.

11. A manufacturing process according to claim 10, characterized in that said first component is provided in a continuous strip, wherein a plurality of first components is linked to a metal band from which the components protrude transversally.

12. A manufacturing process according to claim 10, characterized in that said second component is provided in a continuous strip, wherein a plurality of second components are disposed one after the other in an axial direction connected to each other by thin portions of sheet metal.

13. A manufacturing process according to claim 10 characterized in that said first component (20) comprises second fixing tongues and said process comprises the operation of clinching said second tongues around the inner insulating sheath of the cable.

14. A clinching process for clinching pre-bent sheet metal tongues characterized in that it comprises the following stages:

providing tongues, to be clinched one on the other, in an asymmetrical shape, that is to say one (25d) having its distal end (25'd) extending at least a little further than the distal end (25's) of the other (25s);
engaging firstly said less extended tongue (25s) and then the more extended tongue (25d) with the wall of a die (72) so as to bend firstly the less extended tongue then the more extended tongue on the less extended tongue.

15. A clinching apparatus characterized in that it comprises a first bottom clinching die (70) having flaring sides and a seat to receive a base of an element to be fixed by clinching
a second die (72) provided with a cavity that has a first sloping side (73s) and a second sloping side (73d) with the same angle of inclination as the first but at a different distance from a clinching centre axis (a) compared with the first side, and a rounded end part (73c).

16. A plastic molded insulating shell component for a connector for coaxial cable, characterized in that it comprises two parts provided with engagement means for mutual engagement and in that it comprises means for positioning and insulating contact components of the connector.

FIG.1

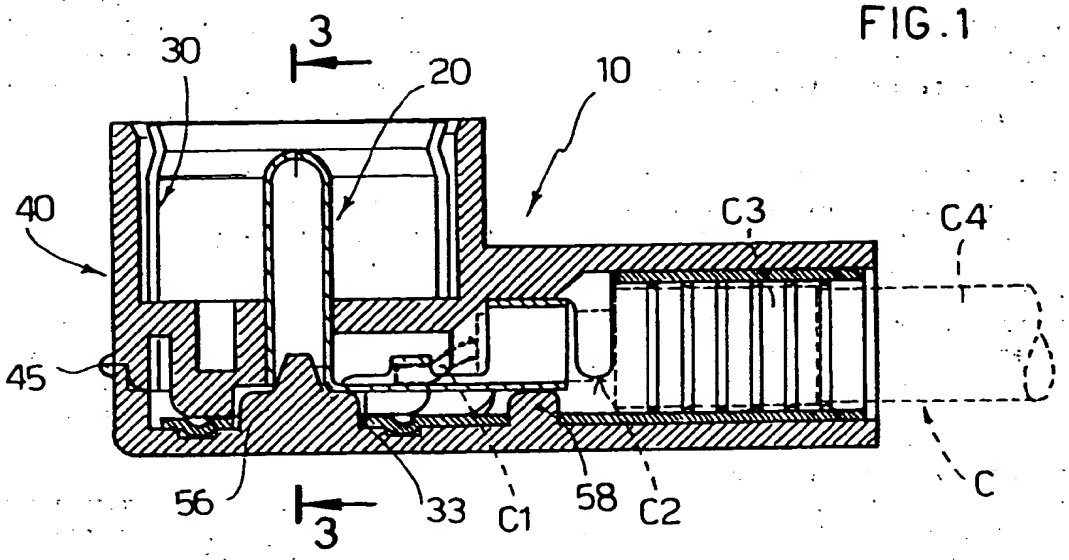


FIG.2

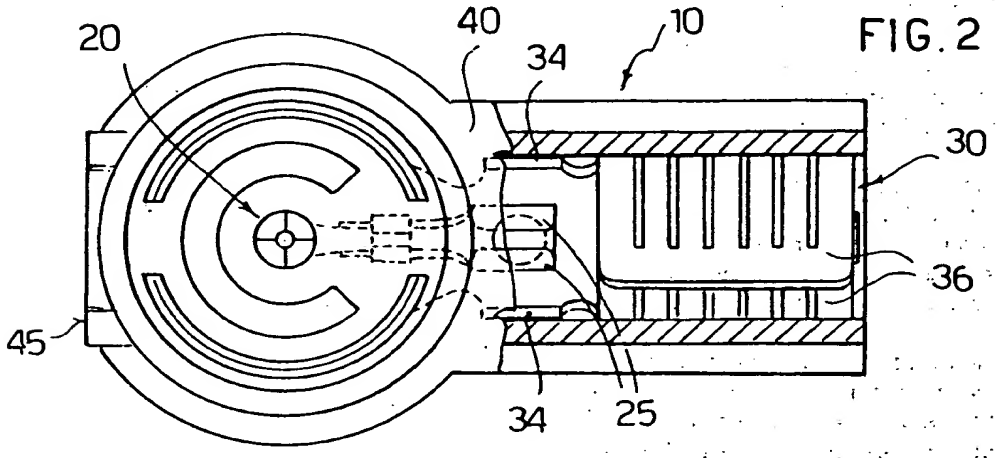
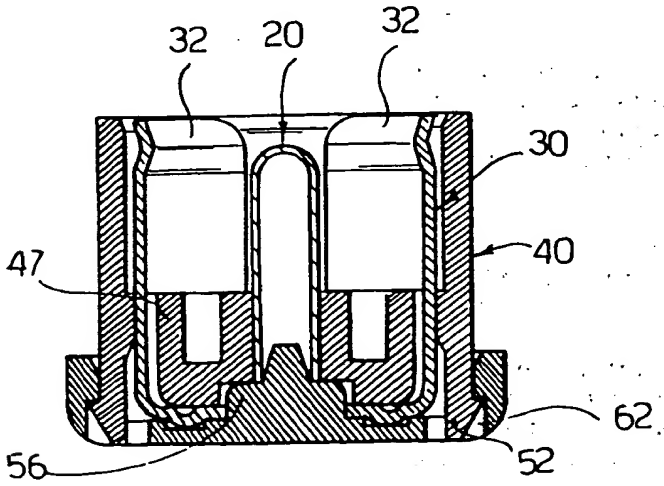


FIG.3



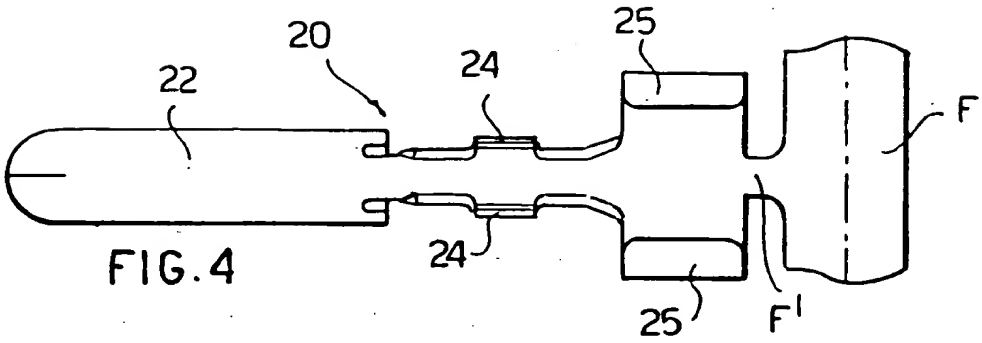
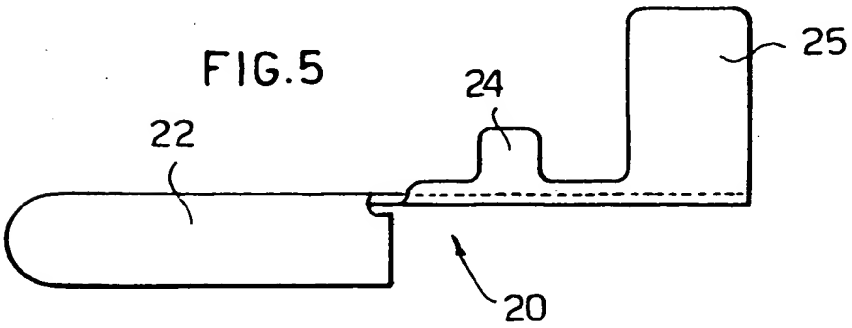


FIG.4

FIG.5



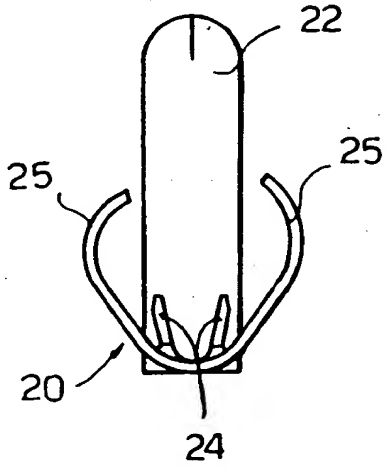


FIG.7

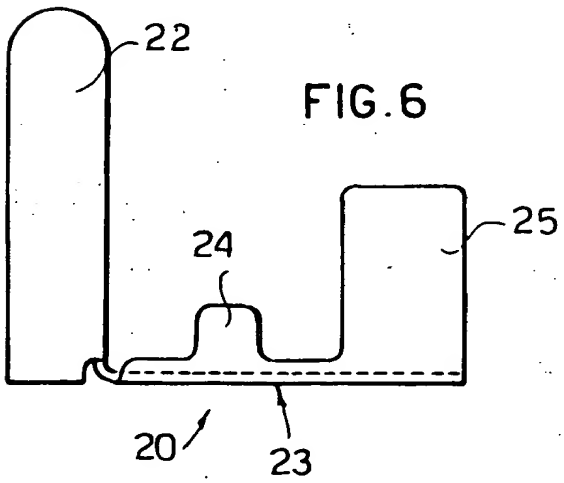


FIG.6

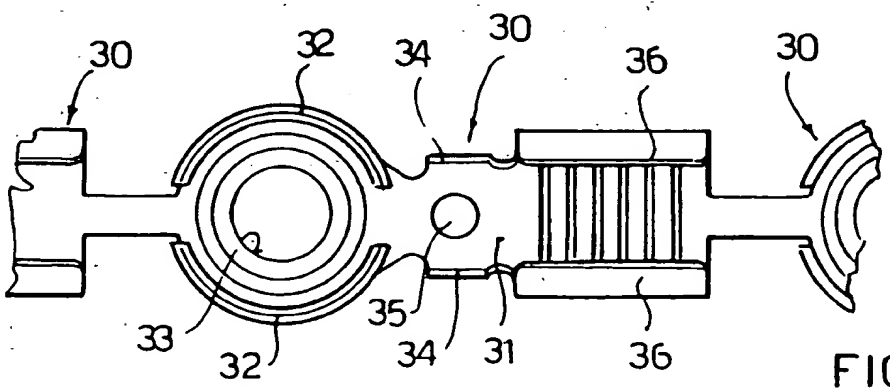


FIG.8

FIG.9

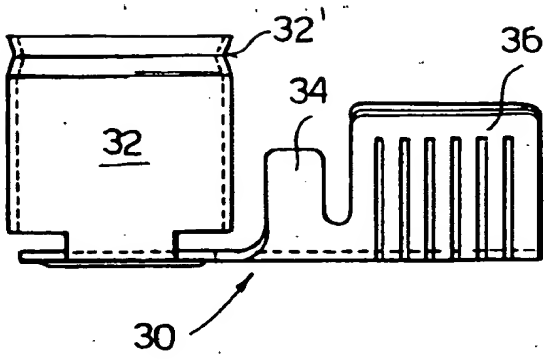
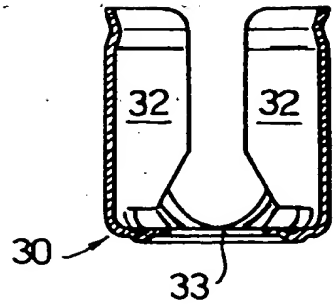


FIG.10



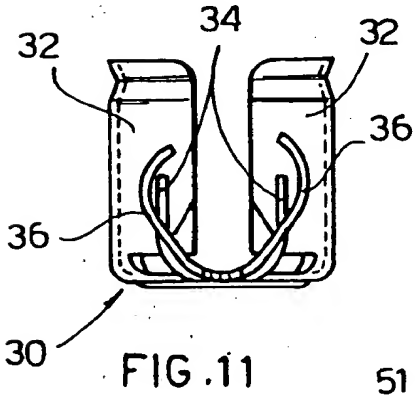


FIG.11

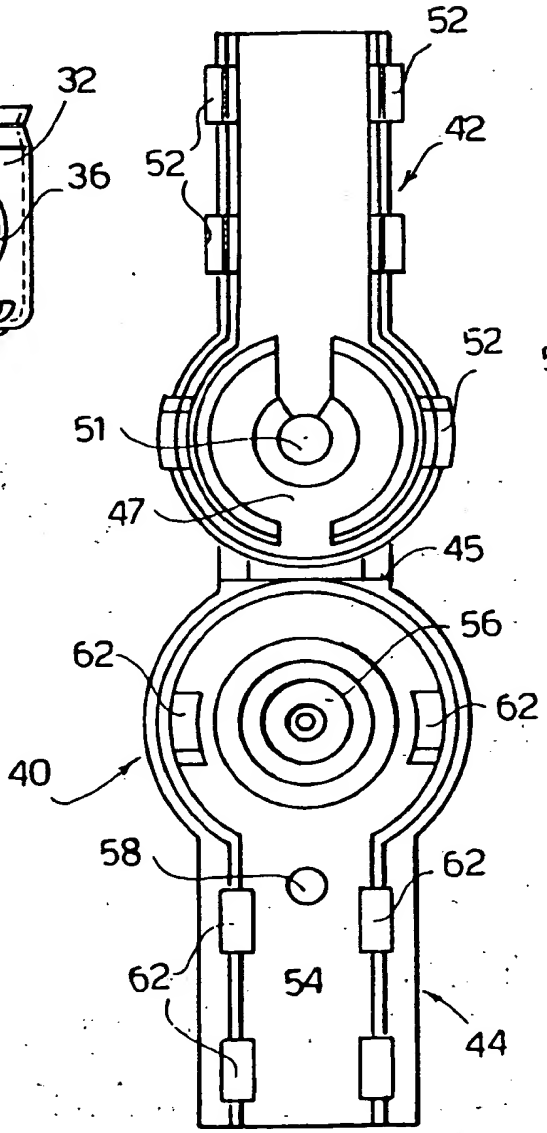


FIG.12

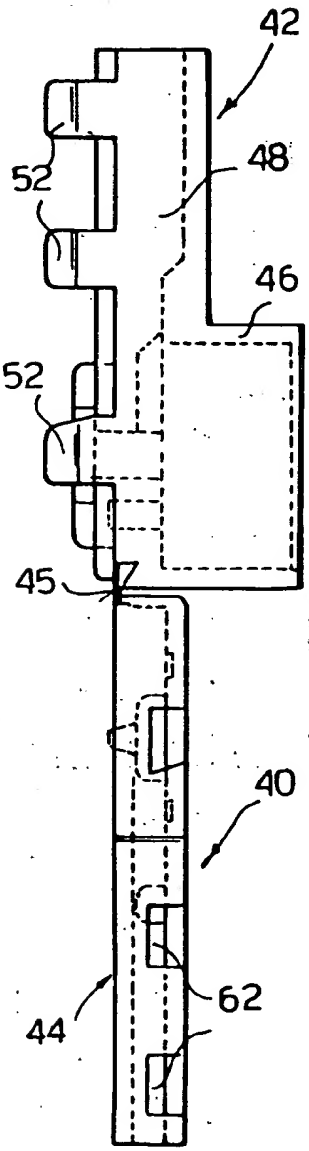


FIG.13

FIG.14

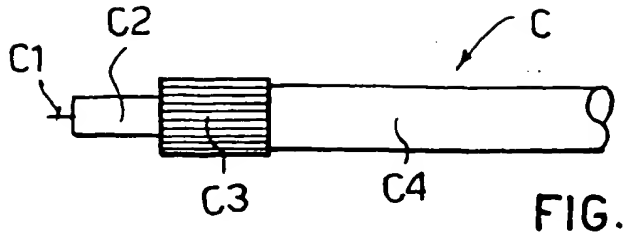


FIG.14a

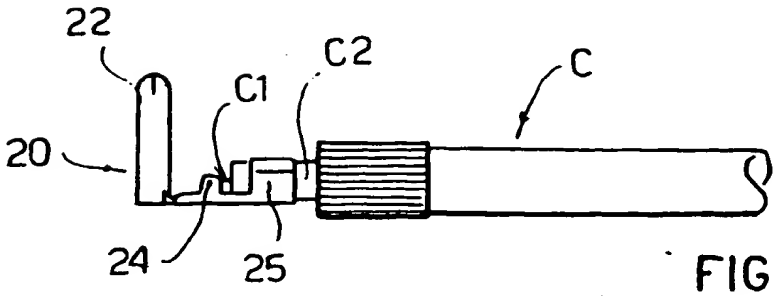


FIG.14b

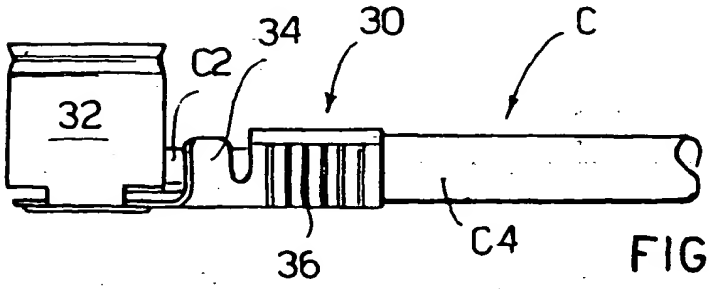


FIG.14c

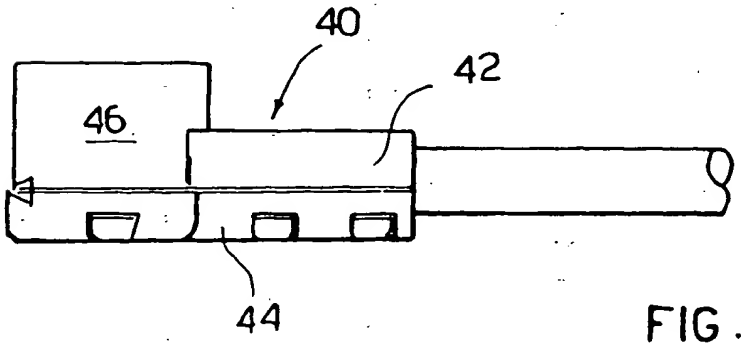


FIG.14d

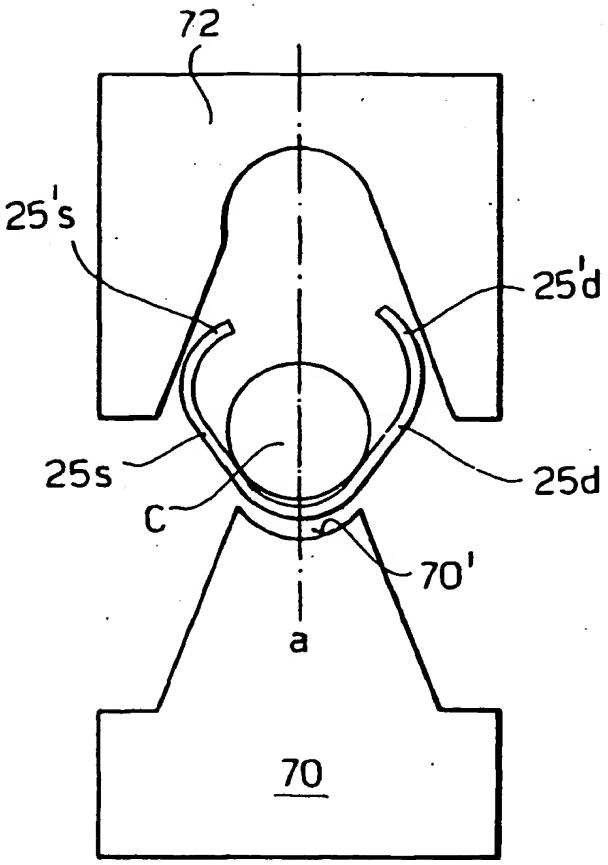


FIG.15a

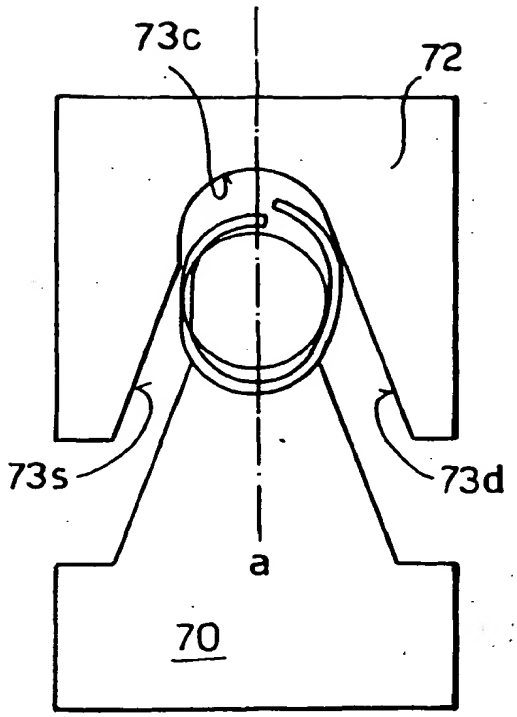


FIG.15b

FIG.15c

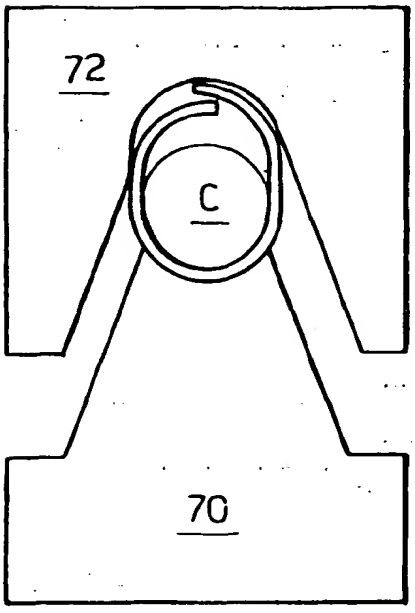
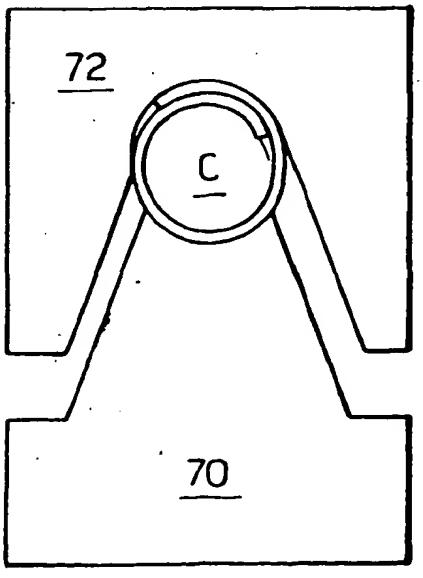


FIG.15d



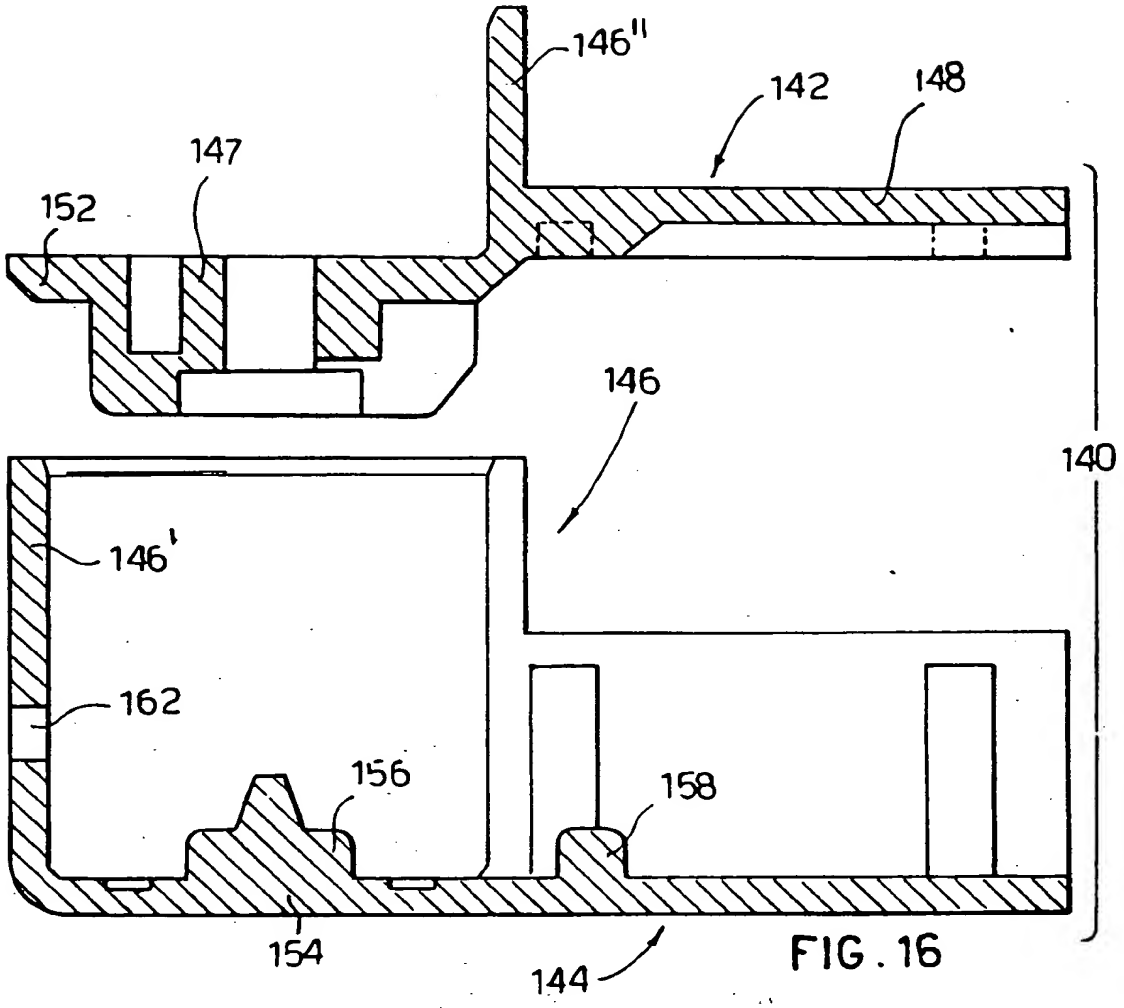

146"
142
148
147
152
146
140
146'
162
156
158
154
144

FIG. 16

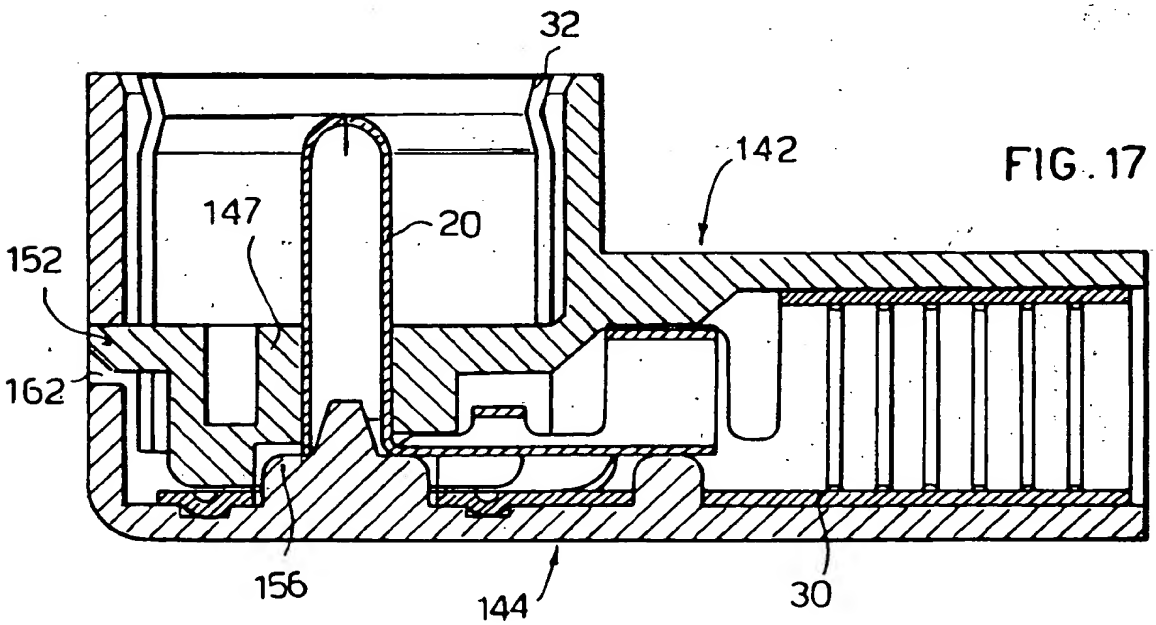

32
142
147
20
152
162
156
144
30

FIG. 17

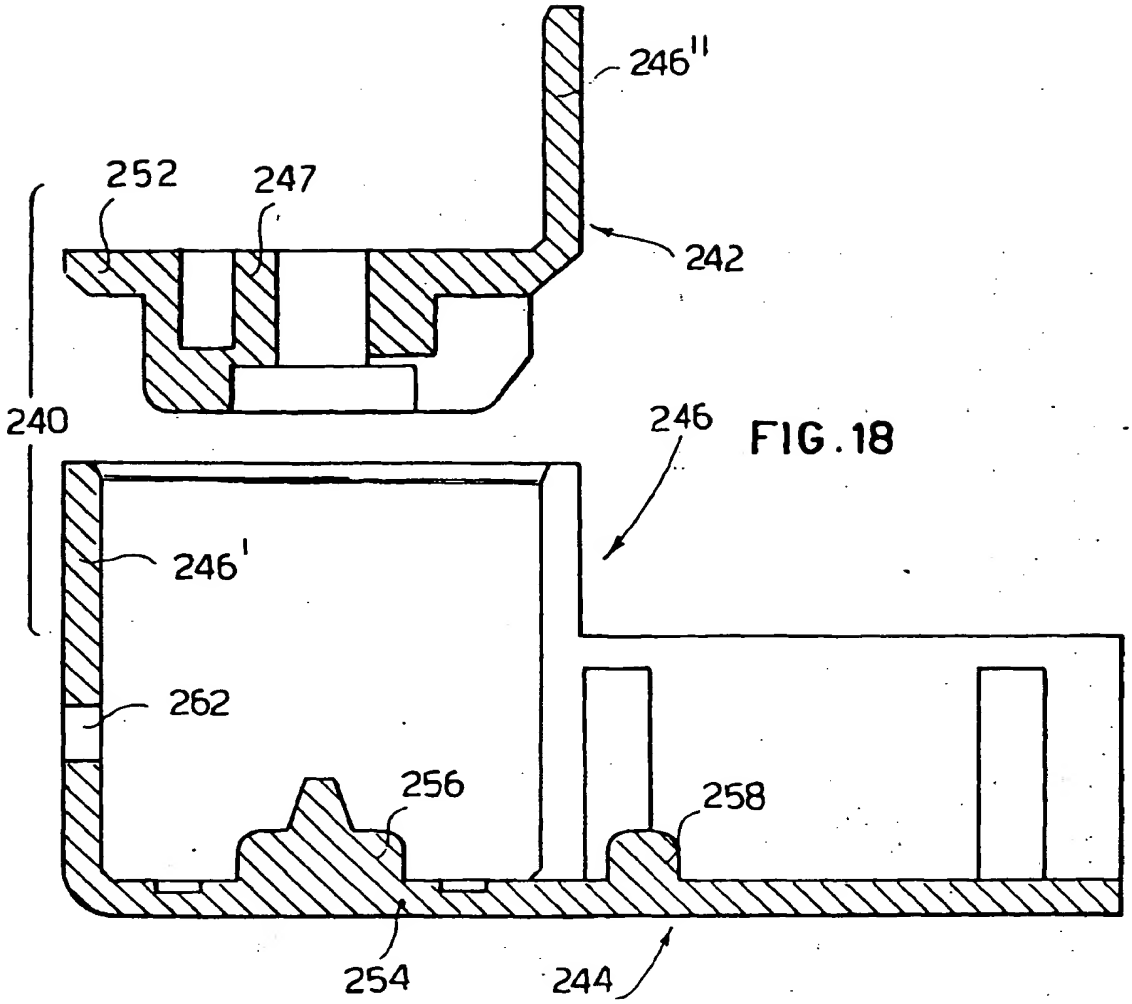

246''
252
247
242
240
246
246'
262
256
258
254
244

FIG. 18

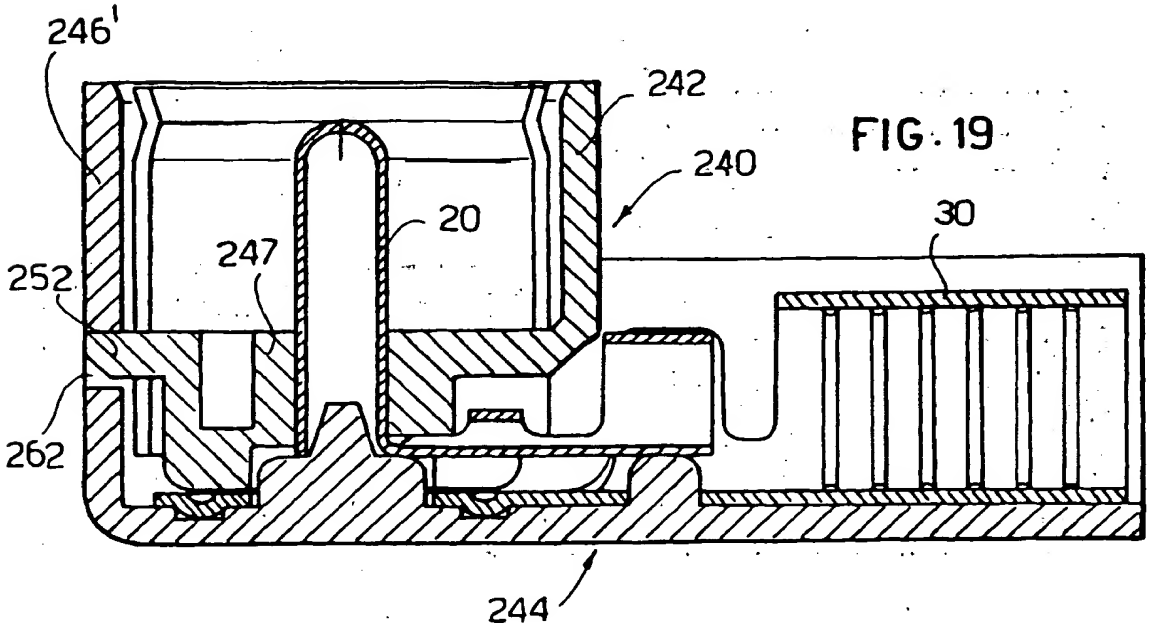
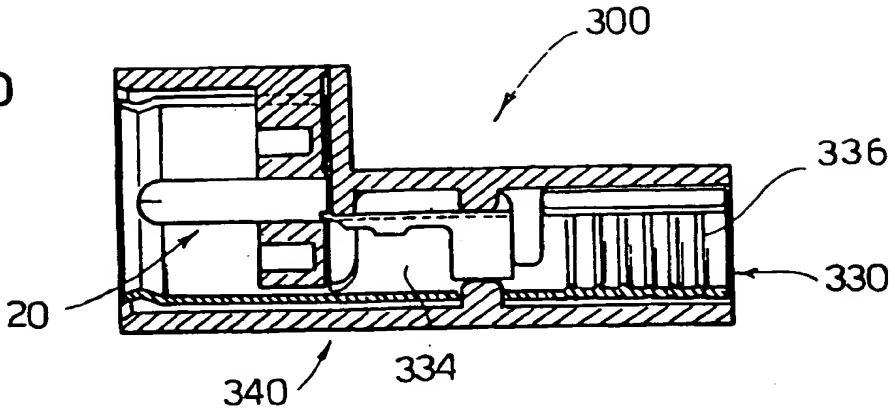

246'
242
240
20
30
247
252
262
244

FIG. 19

FIG. 20



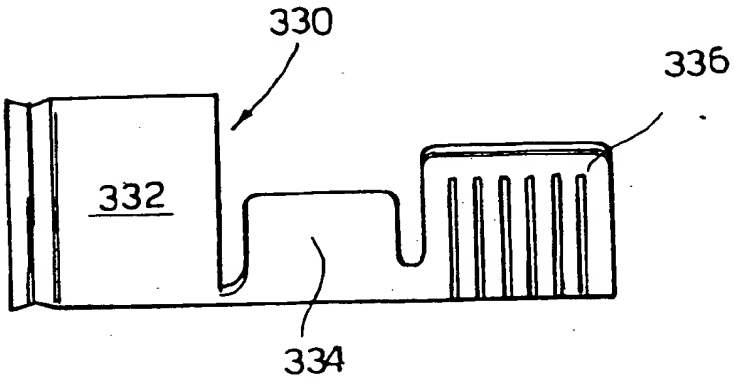
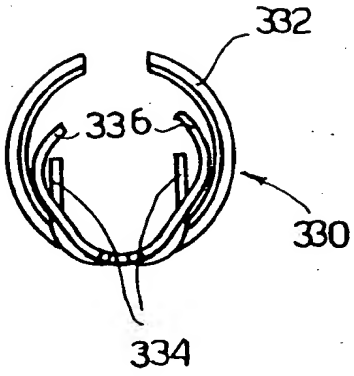


FIG. 21

FIG. 22



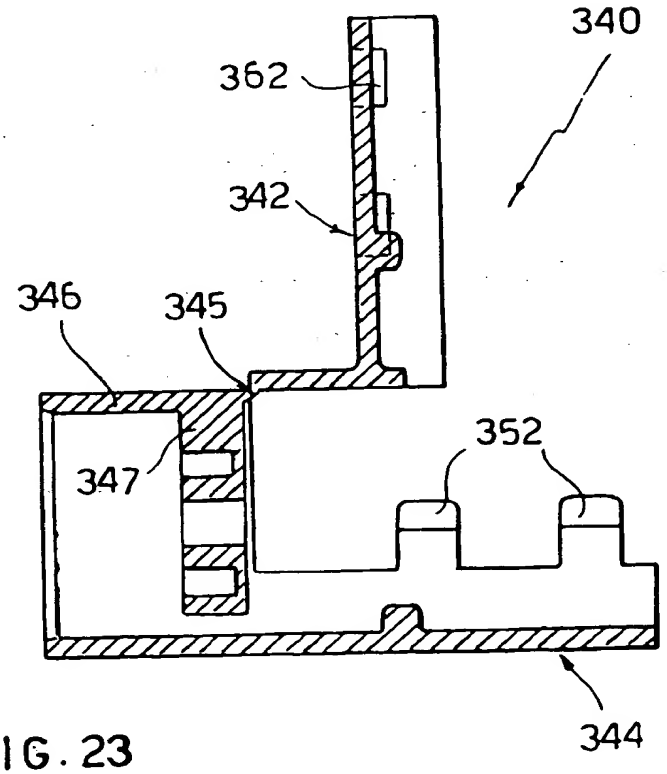


FIG. 23